

**CLAIMS**

What is claimed is:

1. A circuit device, comprising:
  - an insulating substrate;
  - a semiconductor structure positioned on the insulating substrate; and
  - a Peltier effect heat transfer device coupled to the insulating substrate to transfer heat between the semiconductor structure and the insulating substrate.
2. The circuit device of claim 1, wherein the Peltier effect heat transfer device is positioned in the insulating substrate.
3. The circuit device of claim 1, wherein the semiconductor structure comprises an island surrounded by an insulating material.
4. The circuit device of claim 3, wherein the insulating material comprises part of the insulating substrate.
5. The circuit device of claim 3, wherein the insulating material comprises an insulating film positioned on the insulating substrate.
6. The circuit device of claim 5, wherein the Peltier effect heat transfer device is positioned in the insulating film.
7. The circuit device of claim 1, wherein the insulating substrate comprises oxide.
8. The circuit device of claim 1, wherein the semiconductor structure comprises silicon.
9. The circuit device of claim 1, comprising a semiconductor substrate positioned below the insulating substrate.

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10. The circuit device of claim 9, wherein the Peltier effect heat transfer device is positioned partially in the insulating substrate and partially in the semiconductor substrate.
- 5 11. The circuit device of claim 1, wherein the Peltier heat transfer device comprises a plurality of pn junctions connected in series.
- 10 12. A circuit device, comprising:
  - a semiconductor substrate;
  - an insulating substrate positioned on the semiconductor substrate;
  - a semiconductor island positioned on the insulating substrate; and
  - a Peltier effect heat transfer device positioned in the insulating substrate proximate the semiconductor island to transfer heat between the semiconductor island and the insulating substrate.
- 15 13. The circuit device of claim 12, wherein the semiconductor island is surrounded by an insulating material.
- 20 14. The circuit device of claim 13, wherein the insulating material comprises part of the insulating substrate.
15. The circuit device of claim 13, wherein the insulating material comprises an insulating film positioned on the insulating substrate.
- 25 16. The circuit device of claim 12, wherein the insulating substrate comprises oxide.
17. The circuit device of claim 12, wherein the semiconductor island comprises silicon.
- 30 18. The circuit device of claim 12, wherein the Peltier effect heat transfer device is positioned partially in the insulating substrate and partially in the semiconductor substrate.

19. The circuit device of claim 12, wherein the Peltier heat transfer device comprises a plurality of pn junctions connected in series.

5      20. An integrated circuit, comprising:  
an insulating substrate;  
a semiconductor layer positioned on the insulating substrate and having a plurality of active semiconductor island regions;  
a plurality of circuit devices positioned on the semiconductor layer; and  
10      at least one Peltier effect heat transfer device coupled to the insulating substrate to transfer heat between at least one of the active semiconductor island regions and the insulating substrate.

15      21. The circuit device of claim 20, wherein the plurality of semiconductor island regions is surrounded by an insulating material.

20      22. The circuit device of claim 21, wherein the insulating material comprises part of the insulating substrate.

24. The circuit device of claim 21, wherein the insulating material comprises an insulating film positioned on the insulating substrate.

25      25. The circuit device of claim 20, wherein the insulating substrate comprises oxide.

26. The circuit device of claim 20, wherein the plurality of semiconductor island regions comprises silicon.

30      26. The circuit device of claim 20, comprising a semiconductor substrate positioned below the insulating substrate

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5        27. The circuit device of claim 26, wherein the at least one Peltier effect heat transfer device is positioned partially in the insulating substrate and partially in the semiconductor substrate.

10        28. The circuit device of claim 20, wherein the at least one Peltier heat transfer device comprises a plurality of pn junctions connected in series.

15        29. A method of fabricating a circuit structure, comprising:  
              forming an insulating substrate;  
              forming a Peltier effect heat transfer device in the insulating substrate; and  
              forming a semiconductor film on the insulating substrate proximate the Peltier effect heat transfer device.

20        30. The method of claim 29, wherein the step of forming the insulating substrate comprises forming a first insulating film on a semiconductor substrate.

25        31. The method of claim 30, wherein the Peltier effect heat transfer device is formed partially in the insulating substrate and partially in the semiconductor substrate.

30        32. The method of claim 29, wherein the forming of the Peltier heat transfer device comprises forming a plurality of p-type impurity regions connected in series to a plurality of n-type impurity regions to establish a plurality of pn junctions.

              33. The method of claim 32, wherein the forming of the pluralities of p-type and n-type regions comprises forming selectively introducing impurities into the semiconductor layer.

              34. The method of claim 33, wherein the impurities are introduced into the semiconductor layer by ion implantation.

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35. The method of claim 33, wherein the impurities are introduced into the semiconductor layer by diffusion.

5 36. The method of claim 33, wherein the impurities are introduced into the semiconductor layer by in-situ doping.

10 37. The method of claim 32, wherein the forming of the pluralities of p-type and n-type regions comprises forming a plurality of trenches in the insulating substrate and filling the trenches with semiconductor material.

15 38. The method of claim 29, wherein the forming of a semiconductor film on the insulating substrate proximate the Peltier effect heat transfer device comprises forming a plurality of semiconductor island regions and isolating the plurality of semiconductor island regions with portions of the insulating substrate.

20 39. The method of claim 38, wherein the isolating of the semiconductor island regions comprises forming an insulating layer on the insulating substrate, forming a plurality of openings in the insulating layer and filling the openings with a semiconductor material.

25 40. The method of claim 38, wherein the isolating of the semiconductor island regions comprises forming the semiconductor layer on the insulating substrate, forming a plurality of openings in the semiconductor layer and filling the openings with an insulating material.